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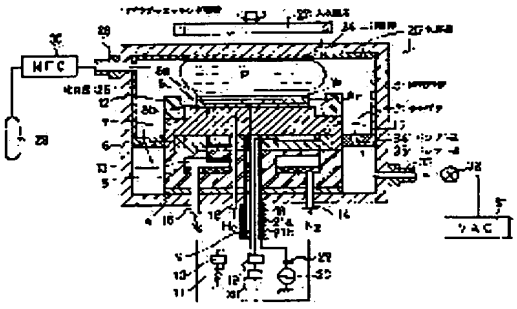
(54) PROCESSING SYSTEM



(57)Abstract:
PURPOSE: To provide a processing system wherein plasma is prevented from running to under an exhaust ring, and wherein damage to its inner wall is reduced.
CONSTITUTION: Insulating layers 25, 26 of 3mm or above in thickness is formed on the inner wall of a processing vessel 2, except for the upper electrode 24 on its ceiling. This turns the flow of plasma away from the inner wall, and thus prevents damage thereto. Further, a baffle 35 is composed of insulating material, and baffle holes 34 are inclined. This increases the inductance of the baffle holes 34, and effectively prevents plasma from running to under the exhaust ring. To cope with increase in exhaust conductance, the inclination is directed toward an exhaust port 33, and the direction of the vacuum pump rotation is made reverse to that of exhaust flow; this makes it possible to maintain a desired exhaust rate.

CLAIMS

[Claim(s)]
[Claim 1] In the vacuum processor which processes the processed object laid on the installation base in the processing container equipped with the raw gas feed hopper and the exhaust port, while establishing said exhaust port caudad rather than the processed object installation side of said installation base The processor which arranges the baffle with which 1 or two or more holes were drilled in the space formed between said exhaust ports and processed object installation sides of said

installation base, and is characterized by making the hole of the baffle incline.
[Claim 2] The processor according to claim 1 which constitutes said baffle from two or more plates with which 1 or two or more holes were drilled in the **** pitch, and is characterized by forming the inclination of the hole of said baffle by shifting each plate horizontally and carrying out a laminating.
[Claim 3] A processor given in either of claims 1 or 2 which is characterized by the hole of said baffle inclining in the direction of said exhaust port.
[Claim 4] A processor given in either of claims 1, 2, or 3 which is characterized by exhausting with the rotating type pump which the flow direction and opposite direction of the exhaust stream produced by the inclination of the hole of said baffle are made to rotate.
[Claim 5] The processor according to claim 4 which said processor is plasma treatment equipment which occurs the plasma and performs plasma treatment to a processed object in a processing container, and is characterized by constituting said baffle from an insulating material.
[Claim 6] The processor according to claim 5 characterized by preparing the insulating layer of said processing container which has the thickness of at least 3mm or more on a side attachment wall at least.
[Claim 7] Some head-lining walls of said processing container are constituted as an electrode which consists of a conductive ingredient. Area of the polar zone is made into the area of the processing side of said processed object at least. A processor given in either of claims 5 or 6 which considers as a location including the field which carried out the orthographic projection of the processing side of said processed object for the location of the polar zone to said head-lining section at least, and is further characterized by preparing the insulating layer which has the thickness of at least 3mm or more in the head-lining wall except said polar zone.
[Claim 8] Plasma treatment equipment given in either of claims 5, 6, or 7 to which said plasma treatment equipment is characterized by being magnetron type plasma treatment equipment which formed the magnet in the method of the outside of a head-lining wall of said processing container.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the plasma treatment equipment which is applied to a processor, especially performs etching processing to processed objects, such as a semi-conductor wafer, using the plasma.
[0002]
[Description of the Prior Art] Conventionally, in the semi-conductor production process, in order to form a detailed pattern to processed objects, such as a semi-conductor wafer, the plasma etching system is used. Especially recently In order to acquire a pattern configuration perpendicular to the processing side of a processed object, a magnet is installed in the upper part of a processing room. A magnetic field parallel to the processing side is formed near the processed object with the magnet, and the plasma treatment equipment of the magnetron method which can orient perpendicularly the active species in the plasma which occurred in the processing interior of a room to a processing side is used widely.
[0003] As shown in drawing 5 , the susceptor assembly 101 for carrying out

installation immobilization of the processed object W, for example, the semi-conductor wafer, is arranged at the processing room 100. The susceptor assembly 101 is constituted from susceptor 101a, susceptor susceptor 101b, and the three-tiered structure of cooling jacket receipt base 101c by the example of illustration. Moreover, while the electrostatic chuck sheet 102 is arranged in the installation side of the top face of the above-mentioned susceptor 101a, the focal ring 103 is arranged to that perimeter, and the processed object W, for example, a semi-conductor wafer, is laid above this electrostatic chuck sheet 102.

[0004] Moreover, the above-mentioned processing room and the above-mentioned susceptor 101a can plasma-ize the raw gas introduced in the processing room 100 from the raw gas installation tubing 106 by consisting of conductive ingredients, such as aluminum, and impressing a desired RF to the above-mentioned susceptor 101a from RF generator 105 through the electric supply rod 104. And it is possible to orient the active species in the plasma which was established free [rotation of a permanent magnet 107] above the above-mentioned processing room 100, formed the magnetic field parallel to the processing side of a processed object, and occurred in the above-mentioned processing room 100 at right angles to the processing side of a processed object. Through the baffle plate 109 with which the exhaust pipe 108 was furthermore installed in the periphery of the above-mentioned susceptor susceptor 101b down the above-mentioned processing room 100, or the hole 110 drilled by the exhaust air ring (or protect ring), it is constituted so that it may be possible to carry out vacuum suction of the inside of the above-mentioned processing room 100 to a predetermined pressure.

[0005]

[Problem(s) to be Solved by the Invention] However, if it was in the above conventional plasma treatment equipments, since the whole wall of the above-mentioned processing room 100 consisted of conductive ingredients and was grounded electrically, in order that a plasma style might collide with not only the processing side of a processed object but a side attachment wall, a head-lining wall, etc., the wall of a processing room was damaged, and metal contamination and raising dust might be caused. Since an electron carried out a drift, the high density plasma occurred near the wall of the processing room 100, as shown like especially the above-mentioned example at drawing 6 in the case of a magnetron method, and especially the damage on a wall was remarkable, it had become a problem. When a baffle plate still like the above-mentioned example was used, the plasma turns also under [for a pore / a baffle], abnormality discharge is produced, the wall and baffle plate of the processing room 100 may be damaged, and the solution was desired.

[0006] The place which this invention is made in view of the trouble which the above conventional plasma treatment equipments hold, and is made into the purpose is a thing [it is possible to prevent the surroundings lump by the baffle lower part of the plasma, and] which can moreover raise exhaust air effectiveness and for which new and the improved plasma treatment equipment are offered while it is possible to control damage on a processing indoor wall.

[0007]

[Means for Solving the Problem] In the plasma treatment equipment which processes the processed object laid in the installation base by the active species in the plasma which occurred in the processing container equipped with the raw gas feed hopper and the exhaust port according to this invention according to claim 1 in order to solve the above-mentioned technical problem While establishing the above-mentioned exhaust port caudad rather than the processed object installation side of the above-

mentioned installation base The baffle with which 1 or two or more holes were drilled in the space formed between the above-mentioned exhaust port and the processed object installation side of the above-mentioned installation base is arranged, and the processor characterized by making the hole of the baffle incline is offered.
[0008] Moreover, the above-mentioned baffle can be formed by shifting and carrying out the laminating of two or more plates with which 1 or two or more holes were drilled horizontally in a **** pitch, respectively so that the hole may incline, as indicated by claim 2. In that case, it is desirable to make the hole of the above-mentioned baffle incline in the direction of the above-mentioned exhaust port as indicated by claim 3. In case vacuum suction is furthermore carried out, it is desirable to exhaust with the rotating type pump which the flow direction and opposite direction of the exhaust stream produced by the inclination of the hole of the above-mentioned baffle are made to rotate as indicated by claim 4. When applying this invention to plasma equipment further again, a thing [constituting the above-mentioned baffle from insulating materials, such as a ceramic and a quartz, like] according to claim 5 is desirable.
[0009] Moreover, according to [it is desirable to prepare the insulating layer of the processing container of the above-mentioned plasma treatment equipment which has the thickness of at least 3mm or more on a side attachment wall at least, and] claim 7, according to claim 6 Furthermore, some head-lining walls of the processing container of the above-mentioned plasma treatment equipment are constituted as an electrode which consists of a conductive ingredient. It is desirable to prepare the insulating layer which considers as a location including the field which area of the polar zone was made [field] into the area of the processing side of the above-mentioned processed object at least, and carried out the orthographic projection of the processing side of the above-mentioned processed object for the location to the above-mentioned head-lining section at least, and has the thickness of at least 3mm or more in the head-lining wall except the above-mentioned polar zone further.
[0010] Furthermore, the effectiveness which was most excellent when it was magnetron type plasma treatment equipment according to claim 8 by which, as for this invention, the above-mentioned plasma treatment equipment formed the magnet in the method of the outside of a head-lining wall of the above-mentioned processing container like is done so.
[0011]
[Function] To claim 1, according to invention of ******, since the hole drilled in the baffle inclines and the impedance of a pore becomes high as compared with the conventional perpendicular hole, the pore of the plasma and the surroundings lump by the lower part can be decreased.
[0012] Although the above inclination holes are difficult to manufacture and generally become the factor which pushes up an initial cost, according to invention according to claim 2, it is possible to constitute a false inclination hole easily by shifting and carrying out the laminating of the plate member by which the hole was punched to two or more sheet horizontal direction in a **** pitch.
[0013] In addition, although an inclination hole has large conductance as compared with the conventional perpendicular hole and there is a possibility that the exhaust air rate of flow may become slow, the delay of the exhaust air rate of flow can be eased by turning the inclination direction of said inclination hole to an exhaust port like invention according to claim 3. Moreover, the delay of the exhaust air rate of flow by having become possible to gather up an exhaust stream and conductance having become large can be further eased like invention according to claim 4 by performing

the hand of cut of a rotating type exhaust air pump to the flow and the opposite direction of an exhaust stream.
[0014] Moreover, like invention according to claim 5, when applying to especially plasma treatment equipment, it is possible by constituting a baffle from insulating materials, such as a ceramic and a quartz, to prevent a surroundings lump of the plasma more effectively. Still like invention according to claim 6 or 7, the damage to the processing indoor wall by the plasma style is mitigable by preparing the insulating layer which has the thickness of 3mm or more to another head-lining wall and another side attachment wall, removing the minimum area required as polar zone, i.e., the area of the processing side of a processed object, at least. Moreover, it becomes possible by applying like especially invention according to claim 8, when plasma treatment equipment is a magnetron method to prevent the damage to the wall of a processing room more effectively.
[0015]
[Example] The plasma treatment equipment constituted based on this invention is explained to a detail about one example applied to the magnetron method plasma etching system, referring to an accompanying drawing below.
[0016] As shown in drawing 1 , the etching system 1 has the processing container 2 as a processing room fabricated by the conductive ingredient, for example, the aluminum by which alumite processing was carried out in the front face, an approximate circle cylinder or in the shape of an abbreviation rectangle, and the susceptor 3 which carries out installation maintenance of the processed object W, for example, the semi-conductor wafer, is installed in this processing container 2. The pedestal 5 of the shape of a cylinder which this installation base 3 is also called a susceptor, has the multiplet structure, and was fixed to the pars basilaris ossis occipitalis in the processing container 2 through the electric insulating plates 4, such as an insulating member, for example, the ceramics etc., It consists of disc-like heater standing ways 6 laid in the top face of this pedestal 5, and an installation base 7 of lower electrode combination laid on the above-mentioned pedestal 5 so that these heater standing ways 6 might be included from the upper part. And these pedestals 5, the heater standing ways 6, and the installation base 7 are formed from a conductive member, for example, aluminum, and are concluded by bolting free [attachment and detachment], respectively.
[0017] Furthermore, a top-face center section is disc-like [which was made convex], and said installation base 7 is established in this central top face as the chuck section for holding a processed object with the semi-conductor wafer W whose electrostatic chuck 8 is a processed object, ****** size, and a desirable path [a little] smaller than the path of Wafer W. This electrostatic chuck 8 consists of electrostatic chuck sheets which pinched electric conduction film 8c, such as copper foil, between film of two sheets 8a which considers as the field which carries out installation maintenance of the wafer W, and consists of macromolecule insulating materials, such as polybenzimidazole, and 8b, and that electric conduction film 8 is connected to the source 11 of the adjustable direct-current high voltage by the electrical-potential-difference supply lead 9 through the filter 10 which cuts a RF the middle, for example, a coil. Therefore, by impressing the high voltage to the electric conduction film 9c, it is constituted by the top face of top film 8a of the electrostatic chuck 8 so that adsorption maintenance of the wafer W can be carried out according to Coulomb force.
[0018] Moreover, around the top-face central heights of the above-mentioned installation base 7, as shown in drawing 1 , the annular focal ring 12 is arranged so

that the periphery of the wafer W on the electrostatic chuck 8 may be surrounded. This focal ring 12 consists of an insulating ingredient which does not draw reactant ion near, and the work to which incidence of the reactant ion is effectively carried out to the inside semi-conductor wafer W is made.

[0019] Moreover, in order to hold the temperature at the time of the plasma treatment of Wafer W by which installation maintenance was carried out on the above-mentioned installation base 7 the optimal The cooling means (refrigerant annular passage) 13, for example, a cooling jacket, is formed in the pedestal 5 of the above-mentioned susceptor 3. Refrigerants, such as liquid nitrogen, are introduced into this cooling jacket 13 through the refrigerant installation tubing 14, and it circulates through the inside of a cooling jacket 13, and it is constituted so that the nitrogen gas which heat exchange was carried out and was evaporated from the refrigerant exhaust pipe 15 may be discharged out of a container.

[0020] In order to improve the heat-conducting characteristic to the wafer W which is the processed object by which adsorption maintenance was carried out on the electrostatic chuck 8 , a series of gas passagewaies 16 are form , and heat transfer gas promotion gas , such as helium , is supply here from the exterior , and it is constitute by the pedestal 5 which furthermore builds in the above-mentioned cooling jacket 13 , and the heater standing ways 6 and the installation base 7 on it so that heat may be promptly transmit to Wafer W .

[0021] Moreover, as a top face is embedded flat-tapped in the annular crevice of this top face, the band-like annular heater 17 for temperature controls with a thickness of about several mm is formed in the heater standing ways 6 inserted between the above-mentioned pedestal 5 and the installation base 7. This heater 17 for temperature control is the configuration which inserted conductive resistance heating elements, such as a tungsten, to insulating sintered compacts, such as alumimium nitride, this resistance heating element generates heat in response to desired power through a filter 19 from a power source with the electric power supply lead 18, and it is constituted so that the amount of heat transfer by which heat transfer of the cold energy from the above-mentioned cooling jacket 13 is carried out to Wafer W may be controlled suitably and temperature control of Wafer W may be performed.

[0022] And the electric supply rod 21 which consists of a conductor fabricated in midair penetrates the heater standing ways 6 and a pedestal 5 in the above-mentioned susceptor 3, and is formed in it. This electric supply rod 21 is constituted by the double pipe structure which consists of outside tubing 21a of the earth side, and inside tubing 21b by the side of RF power application, and the centrum is formed between outside tubing 21a and inside tubing 21b and in the interior of inside tubing, respectively, and it is constituted by these centrums so that it may be possible to circulate inert gas. And inside tubing 21b is connected to RF generator 23 through the blocking capacitor 22, and it is possible to impress a 13.56MHz RF to the installation base 7 at the time of processing. It is possible for the installation base 7 to act as a lower electrode by this configuration, to produce glow discharge between the up electrodes 24 mentioned later, to form the reactant plasma in the processing interior of a room, and to perform etching processing to a processed object in the plasma style.

[0023] The up electrode 24 of the processor 1 shown in drawing 1 consists of conductive ingredients grounded in the exterior installed in the head-lining wall of the processing room which counters the installation side of the above-mentioned installation base 7. According to this invention, let area of this up electrode 24 be the area and the location which include at least the field which carried out the orthographic projection of the minimum area which can make a plasma style irradiate

the installation side of the processed object W laid in the above-mentioned installation base 7, for example, a semi-conductor wafer, i.e., the processing side of a processed object, to the head-lining wall. Thus, although it is possible to usually irradiate sufficient plasma style to the processing side of a processed object by constituting, if processing conditions are accepted, constituting as an up electrode of a bigger area is also possible.

[0024] However, according to this invention, in head-lining walls other than up electrode 24, the insulating layer made from a quartz or a ceramic which has the thickness of at least 3mm or more is prepared, and it is constituted so that the wall of the processing container 2 may be protected from the exposure of the plasma style generated to the processing interior of a room. Moreover, the insulating layer 26 made from a quartz or a ceramic which has the thickness of at least 3mm or more on the side attachment wall of the processing container 2 similarly is formed, and it is protected from the exposure of the plasma style generated to the processing interior of a room. In addition, in the usual etching processing, although about 3mm of the thickness of an insulating layer is enough, it is giving thicker thickness depending on processing conditions, and it is possible to prevent the exposure of a plasma style more effectively. Moreover, it is also possible to also fix an insulating layer to the wall of the processing container 2 with means, such as direct vacuum evaporationo, and to consider as the configuration which the facilities of a maintenance tend to aim at by constituting an insulating layer as a tile-like plate member, and considering as the configuration stuck on the internal surface of the processing container 2 although it is possible.

[0025] Furthermore, in the above-mentioned example, the permanent magnet 27 is formed above the processing container 2 free [rotation], it becomes possible to orient a plasma style perpendicularly to a processing side by forming a magnetic field parallel to the processing side near the processed object W, for example, a semi-conductor wafer, and high etching of an anisotropy can be performed. However, as shown in drawing 6 R> 6, since it has the direction of W, i.e., the inclination for electron flows to gather near the wall, a plasma style is irradiated to the side attachment wall of the processing container 2, and it is easy to produce the damage of a side attachment wall in the case of such an etching system of a magnetron method. However, since the side attachment wall is protected by the insulating layer 26, while according to this invention it can be hard to produce damage, therefore metal contamination and raising dust can decrease and the yield can be raised, the frequency of a maintenance to a side attachment wall can be decreased.

[0026] The raw gas supply system and raw gas exhaust air system of the above-mentioned plasma etching system 1 are explained below. Like illustration, the raw gas feed hopper 28 is formed in the shoulder of the above-mentioned processing container 2, and it is possible to introduce etching gas, such as raw gas 4, for example, CF etc., in the processing container 2 through a rate controller 30 from the source 29 of raw gas. Moreover, the exhaust port 33 connected to exhaust air means, such as a vacuum pump, through the bulb 32 is established in the lower part of the above-mentioned processing container 2, and it is possible to carry out evacuation of the processing interior of a room to a predetermined pressure.

[0027] Moreover, as shown in drawing 2 , the baffle plate 35 with which two or more baffle holes 34 were drilled between the central-site section of the above-mentioned susceptor 3 and the wall of the processing container 2 is arranged so that the above-mentioned susceptor 3 may be surrounded. This baffle plate 35 is for also being called a protect ring or an exhaust air ring, preparing the flow of an exhaust stream, and

exhausting raw gas etc. from the inside of the processing container 2 to homogeneity. And in conventional equipment, although the baffle hole drilled by this baffle plate 35 was only cut to the abbreviation perpendicular direction as shown in drawing 5 , with this configuration, through the baffle hole 34, the susceptor 3 turned caudad, or the plasma produced abnormality discharge of producing a spark in baffle hole 34 part, and it caused metal contamination and raising dust.

[0028] However, according to this invention, since the baffle hole 34 inclines, and it is prepared, therefore the impedance of baffle hole 34 part improves and the inclination of electric field becomes gently-sloping as shown in drawing 3 , a surroundings lump of discharge in baffle hole 34 part and the plasma to baffle plate 35 lower part can be prevented. Especially according to this invention, since the baffle plate 35 consists of insulating materials, such as a quartz and a ceramic, abnormality discharge can be prevented more effectively. In addition, in the example of drawing 1 , since a baffle plate 35 is constituted from an insulating material, and a surroundings lump of the plasma can prevent effectively, the insulating layer is not prepared in the side attachment wall of the downward processing container 2 from a baffle plate 35, but if processing conditions are accepted, it is also possible to prepare an insulating layer also to the side attachment wall of the processing container 2 of the lower part of a baffle plate 35 and the pars-basilaris-ossis-occipitalis wall of the processing container 2.

[0029] By the way, since the inductance in the baffle hole 34 of the baffle plate 35 which inclined based on this invention rises as mentioned above, a surroundings lump of the plasma is prevented effectively, but since the exhaust air conductance of the inclining baffle hole 34 also rises to coincidence, a possibility that exhaust velocity may decrease is in it. However, according to this invention, since the inclination direction of the above-mentioned baffle hole 34 is turned in the exhaust-port 33 direction of the processing container 2, reduction in exhaust velocity is suppressed. Moreover, it becomes possible to gather up an exhaust stream to set up the hand of cut of an exhaust air pump 31 of a rotating type like a turbine pump counterclockwise with an exhaust stream, when an opposite direction, i.e., an exhaust stream, flows clockwise, and improvement in exhaust velocity can be aimed at.

[0030] In addition, although the baffle hole 34 which inclines in a baffle plate 35 is directly drilled in the example shown in drawing 3 , as processing of this inclination hole is shown in drawing 4 in order to require time and effort for example, it is possible to constitute inclining baffle hole 34' by shifting and carrying out the laminating of the baffle plates 35a, 35b, 35c, and 35d of two or more sheets with which the baffle holes 34a, 34b, 34c, and 34d of the same pitch were drilled. Thus, by constituting baffle plate 35', it becomes possible to enjoy the effectiveness which was excellent in this invention, holding down a manufacturing cost.

[0031] The plasma etching system applied to this example as mentioned above is constituted. Next, actuation of the plasma etching system concerning this example is explained briefly.

[0032] First, the gate valve which was prepared in the side attachment wall of the processing container 2 where the inside of the load lock chamber which adjoined the above-mentioned processing container 2 and was prepared is isolated with the exterior and which is not illustrated is opened wide. a funnel -- from a dock room, the semi-conductor wafer W which is a processed object is carried in in the predetermined pressure 2, for example, the 1x10 processing container decompressed by -4 - number Torr extent, and adsorption maintenance is carried out on the electrostatic chuck 8 on the installation base 7 of a susceptor 3. Under the present circumstances, while

circulating a refrigerant to a cooling jacket 13, maintaining this part at -196 degrees C and telling cold energy to a semi-conductor wafer through the installation base 7, the calorific value of the heater 17 for temperature control is controlled, and in being predetermined temperature, for example, low temperature treatment, it carries out adjustment maintenance of the wafer W at the predetermined temperature of the range of -10 degrees C - -200 degrees C. And it is possible to produce glow discharge between the installation base 7 and the up electrode 24 as a lower electrode, and to make raw gas plasma-ize by turning raw gas into processing space and turning ON a sink and RF generator 23 from the raw gas feed hopper 28 prepared in the shoulder of the processing container 2. It is possible in that case for a plasma style to be oriented at right angles to the processing side of a processed object according to an operation of a magnetic field with the upper rotation magnet 27 of the processing container 2, and to perform high etching of an anisotropy.

[0033] Next, the effectiveness of the plasma etching system concerning this example is explained. According to this invention, about parts other than up electrode 24 prepared in the head-lining wall of the processing container 2, the insulating layers 25 and 26 which have the thickness of at least 3mm or more are formed, and the influx of a plasma style is prevented effectively. Moreover, since according to this invention the baffle plate 35 formed between the plasma generating section and the exhaust air section consists of insulating materials, and the baffle hole 34 inclines and is prepared further, an inductance improves and the surroundings lump by the exhaust air section of the plasma is prevented effectively. Consequently, since generating of the particle by abnormality discharge decreases, the yield of a product can be raised. In the above-mentioned example, since the inclination direction of the baffle hole 34 of a baffle plate 35 is turned in the exhaust-port 33 direction, required exhaust velocity can be secured further again in spite of the rise of the exhaust air conductance by the inclination of the baffle hole 34.

[0034] In addition, although the case where this invention was applied to the plasma etching system of a magnetron method was explained if it was in the above-mentioned example, this invention can be applied to the various processors which are not limited to this example but process by putting processed objects, such as etching systems, such as the usual parallel monotonous mold, a heat CVD system, plasma-CVD equipment, and an ashing device, on a reduced pressure ambient atmosphere.

[0035]

[Effect of the Invention] Since the wall section of the processing container except an up electrode is insulated according to this invention as explained above, the plasma style produced in a processing container is irradiated, and the situation which a wall damages can be prevented effectively. Moreover, since according to this invention the baffle hole of the baffle plate between the plasma generating section and the exhaust air section inclines and a high inductance is obtained, it is possible to prevent the surroundings lump by the exhaust air section of the plasma, and metal contamination and generating of raising dust can be prevented beforehand. Moreover, it is possible by turning the inclination direction in the direction of an exhaust port, and making the hand of cut of an exhaust air pump further opposite to the direction of an exhaust stream to the rise of the exhaust air conductance by the inclination of a baffle hole, to maintain desired exhaust velocity.

TECHNICAL FIELD

[Industrial Application] This invention relates to the plasma treatment equipment which is applied to a processor, especially performs etching processing to processed objects, such as a semi-conductor wafer, using the plasma.

PRIOR ART

[Description of the Prior Art] Conventionally, in the semi-conductor production process, in order to form a detailed pattern to processed objects, such as a semi-conductor wafer, the plasma etching system is used. Especially recently In order to acquire a pattern configuration perpendicular to the processing side of a processed object, a magnet is installed in the upper part of a processing room. A magnetic field parallel to the processing side is formed near the processed object with the magnet, and the plasma treatment equipment of the magnetron method which can orient perpendicularly the active species in the plasma which occurred in the processing interior of a room to a processing side is used widely.

[0003] As shown in drawing 5 , the susceptor assembly 101 for carrying out installation immobilization of the processed object W, for example, the semi-conductor wafer, is arranged at the processing room 100. The susceptor assembly 101 is constituted from susceptor 101a, susceptor susceptor 101b, and the three-tiered structure of cooling jacket receipt base 101c by the example of illustration. Moreover, while the electrostatic chuck sheet 102 is arranged in the installation side of the top face of the above-mentioned susceptor 101a, the focal ring 103 is arranged to that perimeter, and the processed object W, for example, a semi-conductor wafer, is laid above this electrostatic chuck sheet 102.

[0004] Moreover, the above-mentioned processing room and the above-mentioned susceptor 101a can plasma-ize the raw gas introduced in the processing room 100 from the raw gas installation tubing 106 by consisting of conductive ingredients, such as aluminum, and impressing a desired RF to the above-mentioned susceptor 101a from RF generator 105 through the electric supply rod 104. And it is possible to orient the active species in the plasma which was established free [rotation of a permanent magnet 107] above the above-mentioned processing room 100, formed the magnetic field parallel to the processing side of a processed object, and occurred in the above-mentioned processing room 100 at right angles to the processing side of a processed object. Through the baffle plate 109 with which the exhaust pipe 108 was furthermore installed in the periphery of the above-mentioned susceptor susceptor 101b down the above-mentioned processing room 100, or the hole 110 drilled by the exhaust air ring (or protect ring), it is constituted so that it may be possible to carry out vacuum suction of the inside of the above-mentioned processing room 100 to a predetermined pressure.

EFFECT OF THE INVENTION

[Effect of the Invention] Since the wall section of the processing container except an up electrode is insulated according to this invention as explained above, the plasma style produced in a processing container is irradiated, and the situation which a wall damages can be prevented effectively. Moreover, since according to this invention the baffle hole of the baffle plate between the plasma generating section and the exhaust air section inclines and a high inductance is obtained, it is possible to prevent the

surroundings lump by the exhaust air section of the plasma, and metal contamination and generating of raising dust can be prevented beforehand. Moreover, it is possible by turning the inclination direction in the direction of an exhaust port, and making the hand of cut of an exhaust air pump further opposite to the direction of an exhaust stream to the rise of the exhaust air conductance by the inclination of a baffle hole, to maintain desired exhaust velocity.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, if it was in the above conventional plasma treatment equipments, since the whole wall of the above-mentioned processing room 100 consisted of conductive ingredients and was grounded electrically, in order that a plasma style might collide with not only the processing side of a processed object but a side attachment wall, a head-lining wall, etc., the wall of a processing room was damaged, and metal contamination and raising dust might be caused. Since an electron carried out a drift, the high density plasma occurred near the wall of the processing room 100, as shown like especially the above-mentioned example at drawing 6 in the case of a magnetron method, and especially the damage on a wall was remarkable, it had become a problem. When a baffle plate still like the above-mentioned example was used, the plasma turns also under [for a pore / a baffle], abnormality discharge is produced, the wall and baffle plate of the processing room 100 may be damaged, and the solution was desired.
[0006] The place which this invention is made in view of the trouble which the above conventional plasma treatment equipments hold, and is made into the purpose is a thing [it is possible to prevent the surroundings lump by the baffle lower part of the plasma, and] which can moreover raise exhaust air effectiveness and for which new and the improved plasma treatment equipment are offered while it is possible to control damage on a processing indoor wall.

MEANS

[Means for Solving the Problem] In the plasma treatment equipment which processes the processed object laid in the installation base by the active species in the plasma which occurred in the processing container equipped with the raw gas feed hopper and the exhaust port according to this invention according to claim 1 in order to solve the above-mentioned technical problem While establishing the above-mentioned exhaust port caudad rather than the processed object installation side of the above-mentioned installation base The baffle with which 1 or two or more holes were drilled in the space formed between the above-mentioned exhaust port and the processed object installation side of the above-mentioned installation base is arranged, and the processor characterized by making the hole of the baffle incline is offered.
[0008] Moreover, the above-mentioned baffle can be formed by shifting and carrying out the laminating of two or more plates with which 1 or two or more holes were drilled horizontally in a **** pitch, respectively so that the hole may incline, as indicated by claim 2. In that case, it is desirable to make the hole of the above-mentioned baffle incline in the direction of the above-mentioned exhaust port as indicated by claim 3. In case vacuum suction is furthermore carried out, it is desirable to exhaust with the rotating type pump which the flow direction and opposite

direction of the exhaust stream produced by the inclination of the hole of the above-mentioned baffle are made to rotate as indicated by claim 4. When applying this invention to plasma equipment further again, a thing [constituting the above-mentioned baffle from insulating materials, such as a ceramic and a quartz, like] according to claim 5 is desirable.

[0009] Moreover, according to [it is desirable to prepare the insulating layer of the processing container of the above-mentioned plasma treatment equipment which has the thickness of at least 3mm or more on a side attachment wall at least, and] claim 7, according to claim 6 Furthermore, some head-lining walls of the processing container of the above-mentioned plasma treatment equipment are constituted as an electrode which consists of a conductive ingredient. It is desirable to prepare the insulating layer which considers as a location including the field which area of the polar zone was made [field] into the area of the processing side of the above-mentioned processed object at least, and carried out the orthographic projection of the processing side of the above-mentioned processed object for the location to the above-mentioned head-lining section at least, and has the thickness of at least 3mm or more in the head-lining wall except the above-mentioned polar zone further.

[0010] Furthermore, the effectiveness which was most excellent when it was magnetron type plasma treatment equipment according to claim 8 by which, as for this invention, the above-mentioned plasma treatment equipment formed the magnet in the method of the outside of a head-lining wall of the above-mentioned processing container like is done so.

OPERATION

[Function] To claim 1, according to invention of ******, since the hole drilled in the baffle inclines and the impedance of a pore becomes high as compared with the conventional perpendicular hole, the pore of the plasma and the surroundings lump by the lower part can be decreased.

[0012] Although the above inclination holes are difficult to manufacture and generally become the factor which pushes up an initial cost, according to invention according to claim 2, it is possible to constitute a false inclination hole easily by shifting and carrying out the laminating of the plate member by which the hole was punched to two or more sheet horizontal direction in a **** pitch.

[0013] In addition, although an inclination hole has large conductance as compared with the conventional perpendicular hole and there is a possibility that the exhaust air rate of flow may become slow, the delay of the exhaust air rate of flow can be eased by turning the inclination direction of said inclination hole to an exhaust port like invention according to claim 3. Moreover, the delay of the exhaust air rate of flow by having become possible to gather up an exhaust stream and conductance having become large can be further eased like invention according to claim 4 by performing the hand of cut of a rotating type exhaust air pump to the flow and the opposite direction of an exhaust stream.

[0014] Moreover, like invention according to claim 5, when applying to especially plasma treatment equipment, it is possible by constituting a baffle from insulating materials, such as a ceramic and a quartz, to prevent a surroundings lump of the plasma more effectively. Still like invention according to claim 6 or 7, the damage to the processing indoor wall by the plasma style is mitigable by preparing the insulating layer which has the thickness of 3mm or more to another head-lining wall and another

side attachment wall, removing the minimum area required as polar zone, i.e., the area of the processing side of a processed object, at least. Moreover, it becomes possible by applying like especially invention according to claim 8, when plasma treatment equipment is a magnetron method to prevent the damage to the wall of a processing room more effectively.

EXAMPLE

[Example] The plasma treatment equipment constituted based on this invention is explained to a detail about one example applied to the magnetron method plasma etching system, referring to an accompanying drawing below.

[0016] As shown in drawing 1 , the etching system 1 has the processing container 2 as a processing room fabricated by the conductive ingredient, for example, the aluminum by which alumite processing was carried out in the front face, an approximate circle cylinder or in the shape of an abbreviation rectangle, and the susceptor 3 which carries out installation maintenance of the processed object W, for example, the semi-conductor wafer, is installed in this processing container 2. The pedestal 5 of the shape of a cylinder which this installation base 3 is also called a susceptor, has the multiplet structure, and was fixed to the pars basilaris ossis occipitalis in the processing container 2 through the electric insulating plates 4, such as an insulating member, for example, the ceramics etc., It consists of disc-like heater standing ways 6 laid in the top face of this pedestal 5, and an installation base 7 of lower electrode combination laid on the above-mentioned pedestal 5 so that these heater standing ways 6 might be included from the upper part. And these pedestals 5, the heater standing ways 6, and the installation base 7 are formed from a conductive member, for example, aluminum, and are concluded by bolting free [attachment and detachment], respectively.

[0017] Furthermore, a top-face center section is disc-like [which was made convex], and said installation base 7 is established in this central top face as the chuck section for holding a processed object with the semi-conductor wafer W whose electrostatic chuck 8 is a processed object, ****** size, and a desirable path [a little] smaller than the path of Wafer W. This electrostatic chuck 8 consists of electrostatic chuck sheets which pinched electric conduction film 8c, such as copper foil, between film of two sheets 8a which considers as the field which carries out installation maintenance of the wafer W, and consists of macromolecule insulating materials, such as polybenzimidazole, and 8b, and that electric conduction film 8 is connected to the source 11 of the adjustable direct-current high voltage by the electrical-potential-difference supply lead 9 through the filter 10 which cuts a RF the middle, for example, a coil. Therefore, by impressing the high voltage to the electric conduction film 9c, it is constituted by the top face of top film 8a of the electrostatic chuck 8 so that adsorption maintenance of the wafer W can be carried out according to Coulomb force.

[0018] Moreover, around the top-face central heights of the above-mentioned installation base 7, as shown in drawing 1 , the annular focal ring 12 is arranged so that the periphery of the wafer W on the electrostatic chuck 8 may be surrounded. This focal ring 12 consists of an insulating ingredient which does not draw reactant ion near, and the work to which incidence of the reactant ion is effectively carried out to the inside semi-conductor wafer W is made.

[0019] Moreover, in order to hold the temperature at the time of the plasma treatment

of Wafer W by which installation maintenance was carried out on the above-mentioned installation base 7 the optimal The cooling means (refrigerant annular passage) 13, for example, a cooling jacket, is formed in the pedestal 5 of the above-mentioned susceptor 3. Refrigerants, such as liquid nitrogen, are introduced into this cooling jacket 13 through the refrigerant installation tubing 14, and it circulates through the inside of a cooling jacket 13, and it is constituted so that the nitrogen gas which heat exchange was carried out and was evaporated from the refrigerant exhaust pipe 15 may be discharged out of a container.

[0020] In order to improve the heat-conducting characteristic to the wafer W which is the processed object by which adsorption maintenance was carried out on the electrostatic chuck 8 , a series of gas passagewaies 16 are form , and heat transfer gas promotion gas , such as helium , is supply here from the exterior , and it is constitute by the pedestal 5 which furthermore builds in the above-mentioned cooling jacket 13 , and the heater standing ways 6 and the installation base 7 on it so that heat may be promptly transmit to Wafer W .

[0021] Moreover, as a top face is embedded flat-tapped in the annular crevice of this top face, the band-like annular heater 17 for temperature controls with a thickness of about several mm is formed in the heater standing ways 6 inserted between the above-mentioned pedestal 5 and the installation base 7. This heater 17 for temperature control is the configuration which inserted conductive resistance heating elements, such as a tungsten, to insulating sintered compacts, such as alumimium nitride, this resistance heating element generates heat in response to desired power through a filter 19 from a power source with the electric power supply lead 18, and it is constituted so that the amount of heat transfer by which heat transfer of the cold energy from the above-mentioned cooling jacket 13 is carried out to Wafer W may be controlled suitably and temperature control of Wafer W may be performed.

[0022] And the electric supply rod 21 which consists of a conductor fabricated in midair penetrates the heater standing ways 6 and a pedestal 5 in the above-mentioned susceptor 3, and is formed in it. This electric supply rod 21 is constituted by the double pipe structure which consists of outside tubing 21a of the earth side, and inside tubing 21b by the side of RF power application, and the centrum is formed between outside tubing 21a and inside tubing 21b and in the interior of inside tubing, respectively, and it is constituted by these centrums so that it may be possible to circulate inert gas. And inside tubing 21b is connected to RF generator 23 through the blocking capacitor 22, and it is possible to impress a 13.56MHz RF to the installation base 7 at the time of processing. It is possible for the installation base 7 to act as a lower electrode by this configuration, to produce glow discharge between the up electrodes 24 mentioned later, to form the reactant plasma in the processing interior of a room, and to perform etching processing to a processed object in the plasma style.

[0023] The up electrode 24 of the processor 1 shown in drawing 1 consists of conductive ingredients grounded in the exterior installed in the head-lining wall of the processing room which counters the installation side of the above-mentioned installation base 7. According to this invention, let area of this up electrode 24 be the area and the location which include at least the field which carried out the orthographic projection of the minimum area which can make a plasma style irradiate the installation side of the processed object W laid in the above-mentioned installation base 7, for example, a semi-conductor wafer, i.e., the processing side of a processed object, to the head-lining wall. Thus, although it is possible to usually irradiate sufficient plasma style to the processing side of a processed object by constituting, if processing conditions are accepted, constituting as an up electrode of a bigger area is

also possible.
[0024] However, according to this invention, in head-lining walls other than up electrode 24, the insulating layer made from a quartz or a ceramic which has the thickness of at least 3mm or more is prepared, and it is constituted so that the wall of the processing container 2 may be protected from the exposure of the plasma style generated to the processing interior of a room. Moreover, the insulating layer 26 made from a quartz or a ceramic which has the thickness of at least 3mm or more on the side attachment wall of the processing container 2 similarly is formed, and it is protected from the exposure of the plasma style generated to the processing interior of a room. In addition, in the usual etching processing, although about 3mm of the thickness of an insulating layer is enough, it is giving thicker thickness depending on processing conditions, and it is possible to prevent the exposure of a plasma style more effectively. Moreover, it is also possible to also fix an insulating layer to the wall of the processing container 2 with means, such as direct vacuum evaporationo, and to consider as the configuration which the facilities of a maintenance tend to aim at by constituting an insulating layer as a tile-like plate member, and considering as the configuration stuck on the internal surface of the processing container 2 although it is possible.
[0025] Furthermore, in the above-mentioned example, the permanent magnet 27 is formed above the processing container 2 free [rotation], it becomes possible to orient a plasma style perpendicularly to a processing side by forming a magnetic field parallel to the processing side near the processed object W, for example, a semi-conductor wafer, and high etching of an anisotropy can be performed. However, as shown in drawing 6 R> 6, since it has the direction of W, i.e., the inclination for electron flows to gather near the wall, a plasma style is irradiated to the side attachment wall of the processing container 2, and it is easy to produce the damage of a side attachment wall in the case of such an etching system of a magnetron method. However, since the side attachment wall is protected by the insulating layer 26, while according to this invention it can be hard to produce damage, therefore metal contamination and raising dust can decrease and the yield can be raised, the frequency of a maintenance to a side attachment wall can be decreased.
[0026] The raw gas supply system and raw gas exhaust air system of the above-mentioned plasma etching system 1 are explained below. Like illustration, the raw gas feed hopper 28 is formed in the shoulder of the above-mentioned processing container 2, and it is possible to introduce etching gas, such as raw gas 4, for example, CF etc., in the processing container 2 through a rate controller 30 from the source 29 of raw gas. Moreover, the exhaust port 33 connected to exhaust air means, such as a vacuum pump, through the bulb 32 is established in the lower part of the above-mentioned processing container 2, and it is possible to carry out evacuation of the processing interior of a room to a predetermined pressure.
[0027] Moreover, as shown in drawing 2 , the baffle plate 35 with which two or more baffle holes 34 were drilled between the central-site section of the above-mentioned susceptor 3 and the wall of the processing container 2 is arranged so that the above-mentioned susceptor 3 may be surrounded. This baffle plate 35 is for also being called a protect ring or an exhaust air ring, preparing the flow of an exhaust stream, and exhausting raw gas etc. from the inside of the processing container 2 to homogeneity. And in conventional equipment, although the baffle hole drilled by this baffle plate 35 was only cut to the abbreviation perpendicular direction as shown in drawing 5 , with this configuration, through the baffle hole 34, the susceptor 3 turned caudad, or the plasma produced abnormality discharge of producing a spark in baffle hole 34 part,

and it caused metal contamination and raising dust.
[0028] However, according to this invention, since the baffle hole 34 inclines, and it is prepared, therefore the impedance of baffle hole 34 part improves and the inclination of electric field becomes gently-sloping as shown in drawing 3 , a surroundings lump of discharge in baffle hole 34 part and the plasma to baffle plate 35 lower part can be prevented. Especially according to this invention, since the baffle plate 35 consists of insulating materials, such as a quartz and a ceramic, abnormality discharge can be prevented more effectively. In addition, in the example of drawing 1 , since a baffle plate 35 is constituted from an insulating material, and a surroundings lump of the plasma can prevent effectively, the insulating layer is not prepared in the side attachment wall of the downward processing container 2 from a baffle plate 35, but if processing conditions are accepted, it is also possible to prepare an insulating layer also to the side attachment wall of the processing container 2 of the lower part of a baffle plate 35 and the pars-basilaris-ossis-occipitalis wall of the processing container 2.
[0029] By the way, since the inductance in the baffle hole 34 of the baffle plate 35 which inclined based on this invention rises as mentioned above, a surroundings lump of the plasma is prevented effectively, but since the exhaust air conductance of the inclining baffle hole 34 also rises to coincidence, a possibility that exhaust velocity may decrease is in it. However, according to this invention, since the inclination direction of the above-mentioned baffle hole 34 is turned in the exhaust-port 33 direction of the processing container 2, reduction in exhaust velocity is suppressed. Moreover, it becomes possible to gather up an exhaust stream to set up the hand of cut of an exhaust air pump 31 of a rotating type like a turbine pump counterclockwise with an exhaust stream, when an opposite direction, i.e., an exhaust stream, flows clockwise, and improvement in exhaust velocity can be aimed at.
[0030] In addition, although the baffle hole 34 which inclines in a baffle plate 35 is directly drilled in the example shown in drawing 3 , as processing of this inclination hole is shown in drawing 4 in order to require time and effort for example, it is possible to constitute inclining baffle hole 34' by shifting and carrying out the laminating of the baffle plates 35a, 35b, 35c, and 35d of two or more sheets with which the baffle holes 34a, 34b, 34c, and 34d of the same pitch were drilled. Thus, by constituting baffle plate 35', it becomes possible to enjoy the effectiveness which was excellent in this invention, holding down a manufacturing cost.
[0031] The plasma etching system applied to this example as mentioned above is constituted. Next, actuation of the plasma etching system concerning this example is explained briefly.
[0032] First, the gate valve which was prepared in the side attachment wall of the processing container 2 where the inside of the load lock chamber which adjoined the above-mentioned processing container 2 and was prepared is isolated with the exterior and which is not illustrated is opened wide. a funnel -- from a dock room, the semi-conductor wafer W which is a processed object is carried in in the predetermined pressure 2, for example, the 1x10 processing container decompressed by -4 - number Torr extent, and adsorption maintenance is carried out on the electrostatic chuck 8 on the installation base 7 of a susceptor 3. Under the present circumstances, while circulating a refrigerant to a cooling jacket 13, maintaining this part at -196 degrees C and telling cold energy to a semi-conductor wafer through the installation base 7, the calorific value of the heater 17 for temperature control is controlled, and in being predetermined temperature, for example, low temperature treatment, it carries out adjustment maintenance of the wafer W at the predetermined temperature of the range

of -10 degrees C - -200 degrees C. And it is possible to produce glow discharge between the installation base 7 and the up electrode 24 as a lower electrode, and to make raw gas plasma-ize by turning raw gas into processing space and turning ON a sink and RF generator 23 from the raw gas feed hopper 28 prepared in the shoulder of the processing container 2. It is possible in that case for a plasma style to be oriented at right angles to the processing side of a processed object according to an operation of a magnetic field with the upper rotation magnet 27 of the processing container 2, and to perform high etching of an anisotropy.

[0033] Next, the effectiveness of the plasma etching system concerning this example is explained. According to this invention, about parts other than up electrode 24 prepared in the head-lining wall of the processing container 2, the insulating layers 25 and 26 which have the thickness of at least 3mm or more are formed, and the influx of a plasma style is prevented effectively. Moreover, since according to this invention the baffle plate 35 formed between the plasma generating section and the exhaust air section consists of insulating materials, and the baffle hole 34 inclines and is prepared further, an inductance improves and the surroundings lump by the exhaust air section of the plasma is prevented effectively. Consequently, since generating of the particle by abnormality discharge decreases, the yield of a product can be raised. In the above-mentioned example, since the inclination direction of the baffle hole 34 of a baffle plate 35 is turned in the exhaust-port 33 direction, required exhaust velocity can be secured further again in spite of the rise of the exhaust air conductance by the inclination of the baffle hole 34.

[0034] In addition, although the case where this invention was applied to the plasma etching system of a magnetron method was explained if it was in the above-mentioned example, this invention can be applied to the various processors which are not limited to this example but process by putting processed objects, such as etching systems, such as the usual parallel monotonous mold, a heat CVD system, plasma-CVD equipment, and an ashing device, on a reduced pressure ambient atmosphere.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the rough sectional view of the magnetron type plasma etching system constituted based on this invention.

[Drawing 2] It is rough sketch drawing of the baffle plate mounted in the etching system shown in drawing 1 , and a susceptor part.

[Drawing 3] It is a fragmentary sectional view about one example of the baffle plate constituted based on this invention.

[Drawing 4] It is a fragmentary sectional view about other examples of the baffle plate constituted based on this invention.

[Drawing 5] It is the rough sectional view of the conventional magnetron type plasma etching system.

[Drawing 6] It is the explanatory view showing the relation of the magnetic field and processing container by the permanent magnet.

[Description of Notations]

1 Plasma Etching System
2 Processing Container
3 Susceptor
24 Up Electrode

25 Insulating Layer
16 Insulating Layer
27 Permanent Magnet
28 Raw Gas Feed Hopper
31 Exhauster
33 Exhaust Port
34 Baffle Hole
35 Baffle Plate
P Plasma
W Processed object